RADIO-TELEGRAPHY.[1]

THE practical application of electric waves to the purposes of wireless telegraphic transmission over long distances has continued to extend to a remarkable degree during the last few years, and many of the difficulties which at the outset appeared almost insurmountable have been gradually overcome—chiefly through the improved knowledge which we have obtained in regard to the subject generally and to the principles involved.

The experiments which I have been fortunate enough to be able to carry out on a much larger scale than can be done in ordinary laboratories have made possible the investigation of phenomena often novel and certainly unexpected.

Although we have—or believe we have—all the data necessary for the satisfactory production and reception of electric waves, we are yet far from possessing any very exact knowledge concerning the conditions governing the transmission of these waves through space, especially over what may be termed long distances. Although it is now perfectly easy to design, construct, and operate stations capable of satisfactory commercial working over distances up to 2500 miles, no really clear explanation has yet been given of many absolutely authenticated facts concerning these waves. Some of these hitherto apparent anomalies I shall mention briefly in passing.

Why is it that when using short waves the distances covered at night are usually enormously greater than those traversed in the daytime, whilst when using much longer

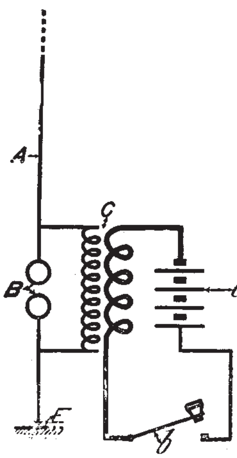

FIG. 1

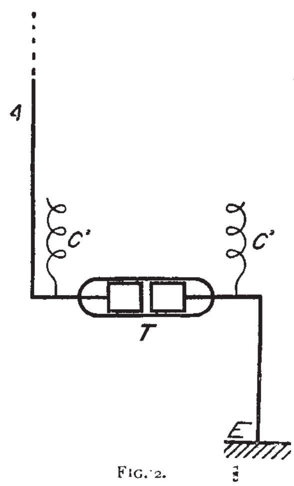

FIG. 2.

waves the range of transmission by day and night is about equal, and sometimes even greater by day?

What explanation has been given of the fact that the night distances obtainable in a north-southerly direction are so much greater than those which can be effected in an east-westerly one?

Why is it that mountains and land generally should greatly obstruct the propagation of short waves when sunlight is present, and not during the hours of darkness?

The general principles on which practical radio-telegraphy is based are now so well known that I need only refer to them in the briefest possible manner.

Wireless telegraphy, which was made possible by the fields of research thrown open by the work of Faraday, Maxwell, and Hertz, is operated by electric waves which are created by alternating currents of very high frequency induced in suitably placed elevated wires or capacity areas. These waves are received or picked up at a distant station on other elevated conductors tuned to the period of the waves, and the latter are revealed to our senses by means of appropriate detectors.

My original system as used in 1896 consisted of the arrangement shown diagrammatically in Fig. 1, where an elevated or vertical wire was employed. This wire sometimes terminated in a capacity, or was connected to earth through a spark gap.

[1] Discourse delivered at the Royal Institution on Friday, June 2, by Commendatore G. Marconi.

By using an induction coil or other source of sufficiently high-tension electricity, sparks were made to jump across the gap; this gave rise to oscillations of high frequency in the elevated conductor and earth, with the result that energy in the form of electric waves was radiated through space.

At the receiving station (Fig. 2) these waves induced oscillatory currents in a conductor containing a detector, in the form of a coherer, which was usually placed between the elevated conductor and earth.

Although this arrangement was extraordinarily efficient in regard to the radiation of electrical energy, it had numerous drawbacks.

The electrical capacity of the system was very small, with the result that the small amount of energy in the aërial was thrown into space in an exceedingly short period of time. In other words the energy, instead of giving rise to a train of waves, was all dissipated after only a few oscillations, and, consequently, anything approaching good tuning between the transmitter and receiver was found to be unobtainable in practice.

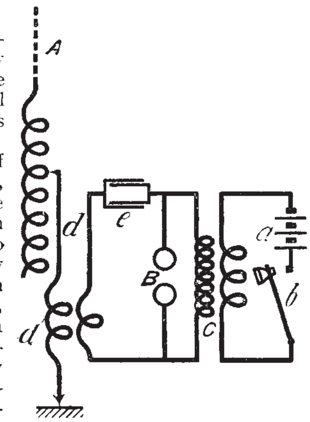

FIG. 3.

Many mechanical analogies could be quoted which show that in order to obtain syntony the operating energy must be supplied in the form of a sufficient number of small oscillations or impulses properly timed. Acoustics furnish us with numerous examples of this fact, such as the resonance produced by the well-known tuning-fork experiment.

Other illustrations of this principle may be given, *e.g.* if we have to set a heavy pendulum in motion by means of small thrusts or impulses, the latter must be timed to the period of the pendulum, as otherwise its oscillations would not acquire any appreciable amplitude.

In 1900 I first adopted the arrangement which is now in general use, and which consists (as shown in Fig. 3) of the inductive association of the elevated radiating wire with a condenser circuit, which may be used to store up a considerable amount of electrical energy and impart it at a slow rate to the radiating wire.

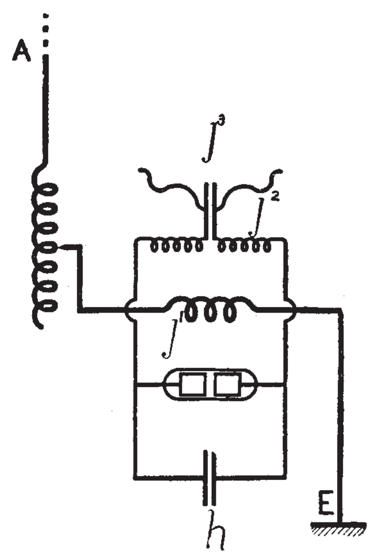

FIG. 4.

As is now well known, the oscillations in a condenser circuit can be made to persist for what is, electrically, a long period of time, and it can be arranged, moreover, that by means of suitable aërials or antennæ these oscillations are radiated into space in the form of a series of waves, which through their cumulative effect are eminently suitable for enabling good tuning or syntony to be obtained between the transmitter and receiver.

The circuits, consisting of the condenser circuit and the elevated aërial or radiating circuit, were more or less closely coupled to each other. By adjusting the inductance

in the elevated conductor, and by the employment of the right value of capacity or inductance required in the condenser circuit, the two circuits were brought into electrical resonance, a condition which I first pointed out as being essential in order to obtain efficient radiation and good tuning.

The receiver (as shown in Fig. 4) also consists of an elevated conductor or aërial connected to earth or capacity through an oscillating transformer. The latter also contains the condenser and detector, the circuits being made to have approximately the same electrical time period as that of the transmitter circuits.

At the long-distance station situated at Clifden in Ireland, the arrangement which has given the best results is based substantially upon my syntonic system of 1900, to which have been added numerous improvements.

An important innovation from a practical point of view was the adoption at Clifden and Glace Bay of air condensers composed of insulated metallic plates suspended in air at ordinary pressure. In this manner we greatly reduce the loss of energy which would take place in consequence of dielectric hysteresis were a glass or solid dielectric employed. A very considerable economy in working also results from the absence of dielectric breakages, for, should the potential be so raised as even to produce a discharge from plate to plate across the condenser, this does not permanently affect the value of the dielectric, as air is self-healing, and one of the few commodities which can be replaced at a minimum of cost.

Various arrangements have been tried and tested for obtaining continuous or very prolonged trains of waves, but it has been my experience that, when utilising the best receivers at present available, it is neither economical nor efficient to attempt to make the waves too continuous. Much better results are obtained when groups of waves (Fig. 5) are emitted at regular intervals in such a manner that their cumulative effect produces a clear musical note in the receiver, which is tuned not only to the periodicity of the electric waves transmitted, but also to their group frequency.

In this manner the receiver may be doubly tuned, with the result that a far greater selectivity can be obtained than by the employment of wave-tuning alone.

In fact, it is quite easy to pick up simultaneously different messages transmitted on the same wave-length, but syntonised to different group frequencies.

So far as wave tuning goes, very good results—almost as good as are obtainable by means of continuous oscillations—can be achieved with groups of waves, the decrement of which is in each group 0·03 or 0·04, which means that about thirty or forty useful oscillations are radiated before their amplitude has become too small to affect perceptibly the receiver.

The condenser circuit at Clifden has a decrement of from 0·015 to 0·03 for fairly long waves.

This persistency of the oscillations has been obtained by the employment of the system shown in Fig. 6, which I first described in a patent taken out in September, 1907. This method eliminates almost completely the spark gap and its consequent resistance, which, as is well known, is the principal cause of the damping or decay of the waves in the usual transmitting circuit.

The apparatus shown in Fig. 6 consists of a metal disc *a* having copper studs firmly fixed at regular intervals in its periphery and placed transversely to its plane. This disc is caused to rotate very rapidly between two other discs *b* by means of a rapidly revolving electric motor or steam turbine. These side discs are also made slowly to turn round in a plane at right angles to that of the middle disc. The connections are as illustrated in the figure. The studs are of such length as just to touch the side discs in passing, and thereby bridge the gap between the latter.

With the frequency employed at Clifden, namely, 45,000, when a potential of 15,000 volts is used on the condenser, the spark gap is practically closed during the time in which one complete oscillation only is taking place, when the peripherical speed of the disc is about 600 feet a second. The result is that the primary circuit can continue oscillating without material loss by resistance in the spark gap. Of course, the number of oscillations which can take place is governed by the breadth or thickness of the side discs, the primary circuit being abruptly opened as soon as the studs attached to the middle disc leave the side discs.

The sudden opening of the primary circuit tends to quench immediately any oscillations which may still persist in the condenser circuit; and this fact carries with it a further and not inconsiderable advantage, for, if the coupling of the condenser circuit to the aërial is of suitable value, the energy of the primary will have practically

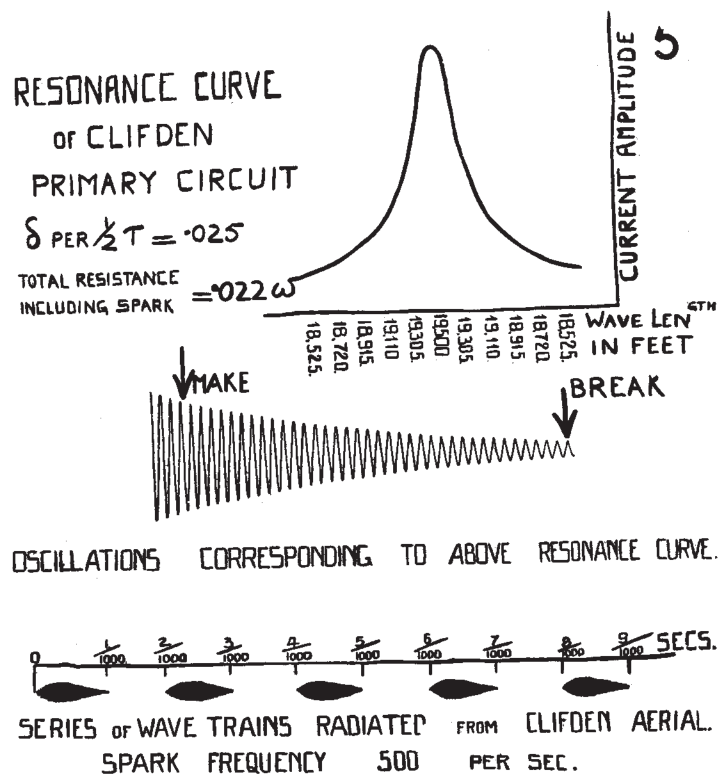

FIG. 5.

all passed to the aërial circuit during the period of time in which the primary condenser circuit is closed by the stud filling the gap between the side discs, but after this the opening of the gap at the discs prevents the energy returning to the condenser circuit from the aërial as would happen were the ordinary spark gap employed. In this manner the usual reaction which would take place between the aërial and the condenser circuit can be obviated, with the result that with this type of discharger and with a suitable degree of coupling the energy is radiated from the aërial in the form of a pure wave, the loss from the spark-gap resistance being reduced to a minimum

I am able to show a resonance curve taken at Clifden, which was obtained from the oscillations in the primary alone (Fig. 5).

An interesting feature of the Clifden plant, especially from a practical and engineering point of view, is the regular employment of high-tension direct current for charging the condenser. Continuous current at a potential which is capable of being raised to 20,000 volts is obtained

by means of special direct-current generators; these machines charge a storage battery consisting of 6000 cells all connected in series, and it may be pointed out that this battery is the largest of its kind in existence. The capacity of each cell is 40 ampere hours. When employing the cells alone, the working voltage is from 11,000 to 12,000 volts, and when both the direct-current generators and the battery are used together the potential may be raised to 15,000 volts through utilising the gassing voltage of the storage cells.

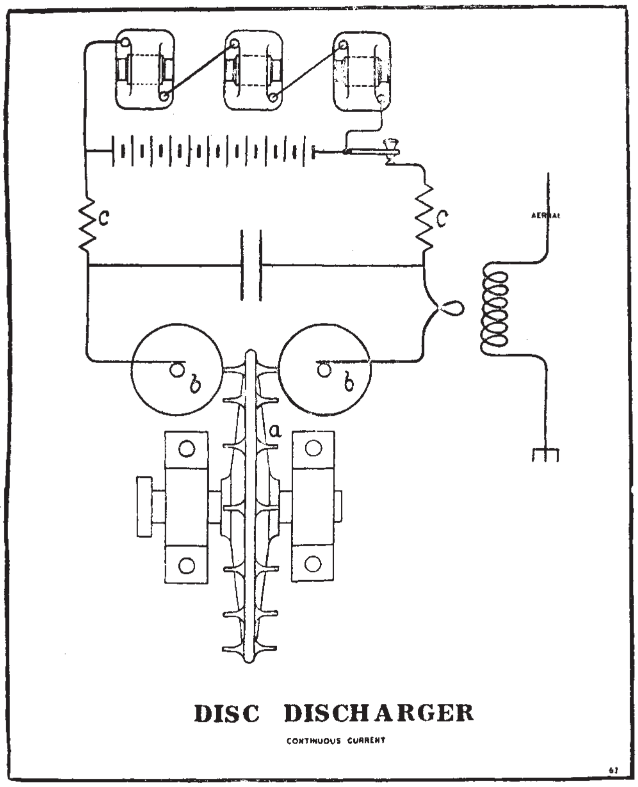

FIG. 6.

For a considerable portion of the day the storage battery alone is employed, with a result that for sixteen hours out of the twenty-four no running machinery need be used for operating the station with the single exception of the small motor revolving the disc.

The potential to which the condenser is charged reaches 18,000 volts when that of the battery or generators is 12,000. This potential is obtained in consequence of the rise of potential at the condenser plates, brought about by the rush of current through the choking or inductance coils at each charge. These coils are placed between the battery or generator and the condenser *c*, Fig. 6.

No practical difficulty has been encountered either at Clifden or Glace Bay in regard to the insulation and maintenance of these high-tension storage batteries. Satisfactory insulation has been obtained by dividing the battery into small sets of cells placed on separate stands. These stands are suspended on insulators attached to girders fixed in the ceiling of the battery-room. A system of switches, which can all be operated electrically and simultaneously, divides the battery into sections, the potential of each section being low enough to enable the cells to be handled without inconvenience or risk.

The arrangement of aërial adopted at Clifden and Glace Bay is shown in Fig. 7. This system, which is based on the result of tests which I first described before the Royal Society in June, 1906,[1] not only makes it possible to radiate efficiently and receive waves of any desired length, but it also tends to confine the main portion of the radiation to any desired direction. The limitation of transmission to one direction is not very sharply defined, but nevertheless the results obtained are exceedingly useful for practical working.

In a similar manner, by means of these horizontal wires, it is possible to define the bearing or direction of a sending station and also limit the receptivity of the receiver to waves arriving from a given direction.

The commercial working of radio-telegraphy and the widespread application of the system on shore and afloat in nearly all parts of the world have greatly facilitated the marshalling of facts and the observation of effects. Many of these, as I have already stated, still await a satisfactory explanation.

A curious result which I first noticed more than nine years ago in long-distance tests carried out on the ss. *Philadelphia*, and which still remains an important feature in long-distance space telegraphy, is the detrimental effect produced by daylight on the propagation of electric waves over great distances.

The generally accepted hypothesis of the cause of this absorption of electric waves in sunlight is founded on the belief that the absorption is due to the ionisation of the gaseous molecules of the air affected by the ultra-violet light, and as the ultra-violet rays which emanate from the sun are largely absorbed in the upper atmosphere of the earth, it is probable that that portion of the earth's atmosphere which is facing the sun will contain more ions or electrons than that which is in darkness, and therefore, as Sir J. J. Thomson has shown,[1] this illuminated or ionised air will absorb some of the energy of the electric waves.

The wave-length of the oscillations employed has much to do with this interesting phenomenon, long waves being subject to the effect of daylight to a very much lesser degree than are short waves.

Although certain physicists thought some years ago that the daylight effect should be more marked on long waves than on short, the reverse has been my experience; indeed, in some Transatlantic experiments, in which waves about 8000 metres long were used, the energy received by day at the distant receiving station was usually greater than that obtained at night.

Recent observation, however, reveals the interesting fact that the effects vary greatly with the direction in which transmission is taking place, the results obtained when transmitting in a northerly and southerly direction being often altogether different from those observed in the easterly and westerly one.

Research in regard to the changes in the strength of the received radiations which are employed for telegraphy across the Atlantic has been recently greatly facilitated by the use of sensitive galvanometers, by means of which the strength of the received signals can be measured with a fair degree of accuracy.

In regard to moderate power stations such as are

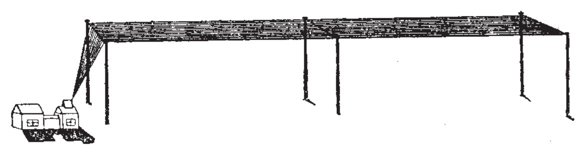

FIG. 7.

employed on ships, and which, in compliance with the International Convention, use wave-lengths of 300 and 600 metres, the distance over which communication can be effected during daytime is generally about the same, whatever the bearing of the ships to each other or to the land stations, whilst at night interesting and apparently curious results are obtained. Ships more than 1000 miles away, off the south of Spain or round the coast of Italy,

[1] "On Methods whereby the Radiation of Electric Waves may be mainly confined," &c. Proceedings of the Royal Society, A. vol. lxxvii., 1906.

[1] See *Philosophical Magazine*, August, 1902, ser. 6, vol. iv., p. 253, J. J. Thomson, "On some Consequences," &c.

can almost always communicate during the hours of darkness with the Post Office stations situated on the coasts of England and Ireland, whilst the same ships when at a similar distance on the Atlantic to the westward of these islands, and on the usual track between England and America, can hardly ever communicate with these shore stations unless by means of specially powerful instruments.

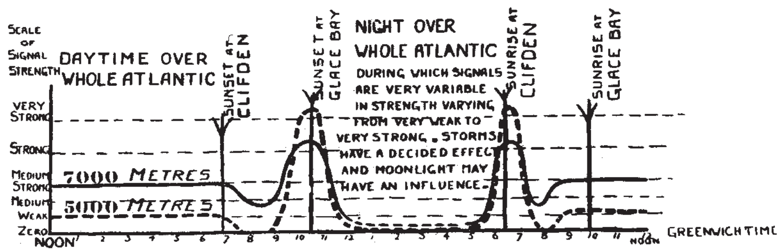

FIG. 8.

It is also to be noticed that in order to reach ships in the Mediterranean the electric waves have to pass over a large portion of Europe and, in many cases, over the Alps. Such long stretches of land, especially when including very high mountains, constitute, as is well known, an insurmountable barrier to the propagation of short waves during daytime. Although no such obstacles lie between the English and Irish stations and ships in the North Atlantic *en route* for North America, a night transmission of 1000 miles is there of exceptionally rare occurrence. The same effects generally are noticeable when ships are communicating with stations situated on the Atlantic coast of America.

Although high-power stations are now used for communicating across the Atlantic Ocean, and messages can be sent by day as well as by night, there still exist periods of fairly regular daily occurrence during which the strength of the received signals is at a minimum. Thus in the morning and the evening, when, in consequence of the difference in longitude, daylight or darkness extends only part of the way across the ocean, the received signals are at their weakest. It would almost appear as if electric waves in passing from dark space to illuminated space, and *vice versa*, were reflected and refracted in such manner as to be diverted from the normal path.

Later results, however, seem to indicate that it is unlikely that this difficulty would be experienced in telegraphing over equal distances north and south on about the same meridian, as, in this case, the passage from daylight to darkness would occur more rapidly over the whole distance between the two stations.

I have here some diagrams which have been carefully prepared by Mr. H. J. Round. These show the average daily variation of the signals received at Clifden from Glace Bay.

The curves traced on diagram No. 8 show the usual variation in the strength of these Transatlantic signals on two wave-lengths, one of 7000 metres and the other of 5000 metres.

The strength of the received waves remains, as a rule, steady during daytime.

Shortly after sunset at Clifden they become gradually weaker, and about two hours later they are at their weakest. They then begin to strengthen again, and reach a very high maximum at about the time of sunset at Glace Bay.

They then gradually return to about normal strength, but through the night they are very variable. Shortly before sunrise at Clifden the signals commence to strengthen steadily, and reach another high maximum shortly after sunrise at Clifden. The received energy then steadily decreases again until it reaches a very marked minimum a short time before sunrise at Glace Bay. After that the signals gradually come back to normal day strength.

It can be noticed that, although the shorter wave gives on the average weaker signals, its maximum and minimum variations of strength very sensibly exceed that of the longer wave.

Diagram 9 shows the variations at Clifden during periods of twenty-four hours, commencing at 12 noon, throughout the month of April, 1911, the vertical dotted lines representing sunset and sunrise at Glace Bay and Clifden.

Diagram 10 shows the curve for the first day of each month for one year from May, 1910, to April, 1911.

I carried out a series of tests over longer distances than had ever been previously attempted in September and October of last year between the stations at Clifden and Glace Bay, and a receiving station placed on the Italian ss. *Principessa Mafalda*, in the course of a voyage from Italy to the Argentine (Fig. 11).

During these tests the receiving wire was supported by means of a kite, as was done in my early Transatlantic tests of 1901, the height of the kite varying from about 1000 to 3000 feet. Signals and messages were obtained without difficulty by day as well as by night up to a distance of 4000 statute miles from Clifden.

Beyond that distance reception could only be carried out during night time. At Buenos Aires, more than 6000 miles from Clifden, the night signals from both Clifden

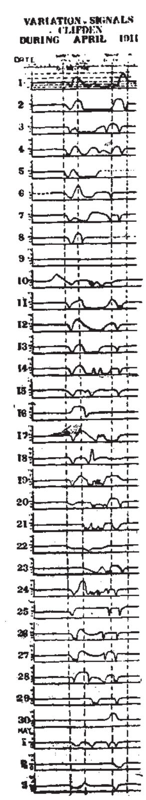

FIG. 9.

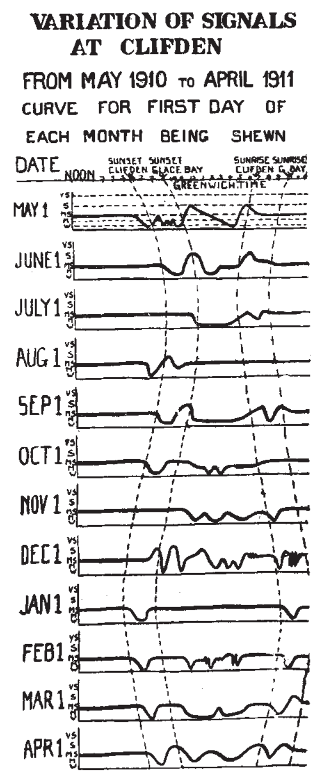

FIG. 10.

and Glace Bay were generally good, but their strength suffered some variations.

It is rather remarkable that the radiations from Clifden should have been detected at Buenos Aires so clearly at night time and not at all during the day, whilst in Canada the signals coming from Clifden (2400 miles distant) are no stronger during the night than they are by day.

Further tests have been carried out recently for the

Italian Government between a station situated at Massaua in East Africa and Coltano in Italy. Considerable interest attached to these experiments in view of the fact that the line connecting the two stations passes over exceedingly dry country and across vast stretches of desert, including parts of Abyssinia, the Sudan, and the Libyan

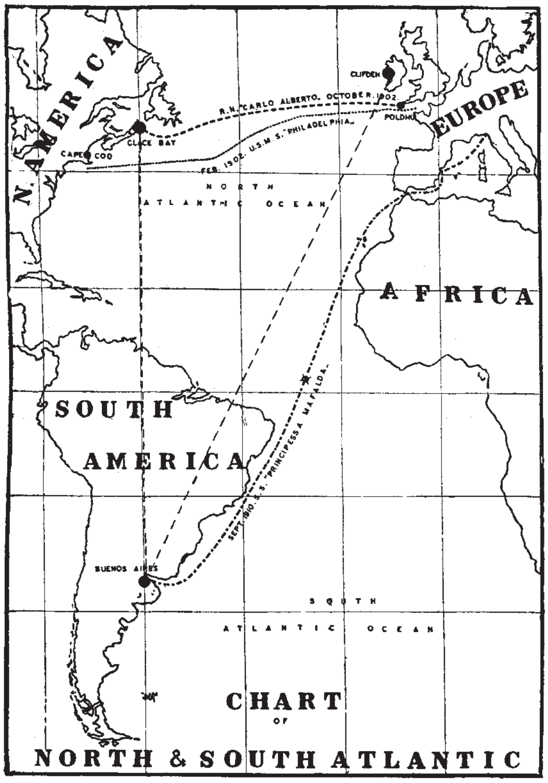

FIG. 11.

Desert. The distance between the two stations is about 2600 miles.

The wave-length of the sending station in Africa was too small to allow of transmission being effected during daytime, but the results obtained during the hours of darkness were exceedingly good, the received signals being quite steady and readable.

The improvements introduced at Clifden and Glace Bay have had the result of greatly minimising the interference to which wireless transmission over long distances was particularly exposed in the early days.

The signals arriving at Clifden from Canada are, as a rule, easily read through any ordinary electrical atmospheric disturbance. This strengthening of the received signals has, moreover, made possible the use of recording instruments which not only give a fixed record of the received messages, but are also capable of being operated at a much higher rate of speed than could ever be obtained by means of an operator reading by sound or sight. The record of the signals is obtained by means of photography in the following manner. A sensitive Einthoven string galvanometer is connected to the magnetic detector or valve receiver, and the deflections of its filament caused by the incoming signals are projected and photographically fixed on a sensitive strip, which is moved along at a suitable speed (Fig. 12). On some of these records, which I am able to show, it is interesting to note the characteristic marks and signs produced amongst the signals by natural electric waves or other electrical disturbances of the atmosphere, which, on account of their doubtful origin, have been called "X's."

Although the mathematical theory of electric wave propagation through space was worked out by Clerk Maxwell more than fifty years ago, and notwithstanding all the experimental evidence obtained in laboratories concerning the nature of these waves, yet, so far, we understand but incompletely the true fundamental principles concerning the manner of propagation of the waves on which wireless telegraph transmission is based. For example, in the early days of wireless telegraphy it was generally believed that the curvature of the earth would constitute an insurmountable obstacle to the transmission of electric wave between widely separated points. For a considerable time not sufficient account was taken of the probable effect of the earth connection, especially in regard to the transmission of oscillations over long distances.

Physicists seemed to consider for a long time that wireless telegraphy was solely dependent on the effects of free Hertzian radiation through space, and it was years before the probable effect of the conductivity of the earth was considered and discussed.

Lord Rayleigh, in referring to Transatlantic radiotelegraphy, stated in a paper read before the Royal Society in May, 1903, that the results which I had obtained in signalling across the Atlantic suggested "a more decided bending or diffraction of the waves round the protuberant earth than had been expected," and, further, said that it imparted a great interest to the theoretical problem.[1] Prof. Fleming in his book on electric-wave telegraphy gives diagrams showing what may be taken to be a diagrammatic representation of the detachment of semi-loops of electric strain from a simple vertical wire (Fig. 13).

As will be seen, these waves do not propagate in the same manner as does free radiation from a classical Hertzian oscillator, but instead glide along the surface of the earth.

Prof. Zenneck[2] has carefully examined the effect of earthed receiving and transmitting aërials, and has endeavoured to show mathematically that when the lines of electrical force, constituting a wave front, pass along a surface of low specific inductive capacity—such as the earth—they become inclined forward, their lower ends being retarded by the resistance of the conductor to which they are attached. It therefore would seem that wireless telegraphy as at present practised is, to some extent at least, dependent on the conductivity of the earth, and that the difference in operation across long distances of sea compared to over land is sufficiently explained by the fact that sea water is a much better conductor than is land.

The importance or utility of the earth connection has been sometimes questioned, but in my opinion no practical

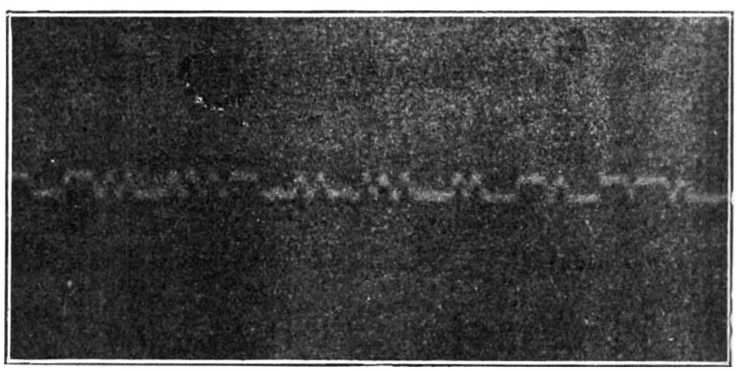

FIG. 12.

system of wireless telegraphy exists where the instruments are not in some manner connected to earth. By connection to earth I do not necessarily mean an ordinary

[1] Proceedings of the Royal Society, vol. lxxii., May 28, 1903.
[2] See J. Zenneck, *Annalen der Physik*, 23. 5. p. 846, September, 1908. *Physikal Zeitschrift*, No. 2, p. 50; No. 17, p. 553.

metallic connection as used for wire telegraphs. The earth wire may have a condenser in series with it, or it may be connected to what is really equivalent, a capacity area placed close to the surface of the ground. It is now perfectly well known that a condenser, if large enough, does not prevent the passage of high-frequency oscillations, and therefore in this case, when a so-called balancing capacity is used, the antenna is for all practical purposes connected to earth.

I am also of opinion that there is absolutely no foundation in the statement, which has recently been repeated, to the effect that an earth connection is detrimental to good tuning, provided, of course, that the earth is good.

Certainly, in consequence of its resistance, what electricians call a bad earth will damp out the oscillations, and in that way make tuning difficult; but no such effect is noticed when employing an efficient earth connection.

In conclusion, I believe that I am not any too bold when I say that wireless telegraphy is tending to revolutionise our means of communication from place to place on the earth's surface. For example, commercial messages containing a total of 812,200 words were sent and received between Clifden and Glace Bay from May 1, 1910, to the end of April, 1911; wireless telegraphy has already furnished means of communication between ships and the shore where communication was before practically impossible. The fact that a system of imperial wireless telegraphy is to be discussed by the Imperial Conference now holding its meetings in London shows the supremely important position which radio-telegraphy over long distances has assumed in the short space of one decade. Its importance from a commercial, naval, and military point of view has increased very greatly during the last few years as a consequence of the innumerable stations which have been erected or are now in course of construction on various coasts, in inland regions, and on board ships in all parts of the world. Notwithstanding this multiplicity of stations and their almost constant operation, I can say from practical experience that mutual interference between properly equipped and efficiently tuned instruments has so far been almost entirely absent. Some interference does without doubt take place between ships in consequence of the fact that the two wave-lengths adopted in accordance with the rules laid down by the International Convention are not sufficient for the proper handling of the very large amount of messages transmitted from the ever-increasing number of ships fitted with wireless telegraphy. A considerable advantage will be obtained by the utilisation of a third and longer wave to be employed exclusively for communication over long distances.

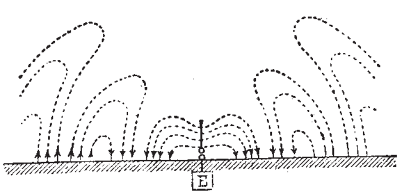

FIG. 13.

In regard to the high-power Transatlantic stations, the facility with which interference has been prevented has to some extent exceeded my expectations. At a receiving station situated at a distance of only eight miles from the powerful sender at Clifden, during a recent demonstration arranged for the Admiralty, messages could be received from Glace Bay without any interference from Clifden when this latter station was transmitting at full power on a wave-length differing only 25 per cent. from the wave radiated from Glace Bay, the ratio between the maximum recorded range of Clifden and 8 miles being in the proportion of 750 to 1.

Arrangements are being made permanently to send and receive simultaneously at these stations, which, when completed, will constitute in effect the duplexing of radio-telegraphic communication between Ireland and Canada.

The result which I have last referred to also goes to show that it would be practicable to operate at one time on slightly different wave-lengths a great number of long-distance stations situated in England and Ireland without danger of mutual interference.

The extended use of wireless telegraphy is principally dependent on the ease with which a number of stations can be efficiently worked in the vicinity of each other.

Considering that the wave-lengths at present in use range from 200 to 23,000 feet, and, moreover, that wave-group tuning and directive systems are now available, it is not difficult to foresee that this comparatively new method of communication is destined to fill a position of the greatest importance in facilitating communication throughout the world.

Apart from long-distance work, the practical value of wireless telegraphy may perhaps be divided into two parts, (1) when used for transmission over sea, (2) when used over land.

Many countries, including Italy, Canada, and Spain, have already supplemented their ordinary telegraph systems by wireless telegraphy installations, but some time must pass before this method of communication will be very largely used for inland purposes in Europe generally, owing to the efficient network of landlines already existing, which render further means of communication unnecessary; and therefore it is probable that, at any rate for the present, the main use of radio-telegraphy will be confined to extra-European countries, in some of which climatic conditions and other causes absolutely prohibit the efficient maintenance of landline telegraphy. A proof of this has been afforded by the success which has attended the working of the stations recently erected in Brazil on the Upper Amazon.

By the majority of people the most marvellous side of wireless telegraphy is perhaps considered to be its use at sea. Up to the time of its introduction, ships at any appreciable distance from land had no means of getting in touch with the shore throughout the whole duration of their voyage. But those who now make long sea journeys are no longer cut off from the rest of the world; business men can continue to correspond at reasonable rates with their offices in America or Europe; ordinary social messages can be exchanged between passengers and their friends on shore; a daily newspaper is published on board most of the principal liners giving the chief news of the day. Wireless telegraphy has on more than one occasion proved an invaluable aid to the course of justice, a well-known instance of which is the arrest which took place recently through its agency of a notorious criminal when about to land in Canada.

The chief benefit, however, of radio-telegraphy lies in the facility which it affords to ships in distress of communicating their plight to neighbouring vessels or coast stations; that it is now considered indispensable for this reason is shown by the fact that several Governments have passed a law making a wireless telegraph installation a compulsory part of the equipment of all passenger boats entering their ports.

THE PROPOSED TEACHERS' REGISTRATION COUNCIL.

IT would seem from the recently published Parliamentary Paper (Cd. 5726), entitled "Further Papers relating to the Registration of Teachers and the proposed Registration Council," that the formation of the much desired Teachers' Council, with which will rest the responsibility of preparing a Register of Teachers, will not be long delayed.

The papers include a summary of proceedings at the conference of November, 1909, convened by the Federal Council of Secondary School Associations in conjunction with other important educational associations; the alternative proposals discussed in Parliament in 1906, and other minutes and important data concerning the formation of such a council of teachers. The most important section, however, is that containing a report by Sir Robert Morant, secretary to the Board of Education, upon three informal conferences held recently at the Board of Education to discuss the whole matter, together with the outline of a scheme for the formation of a Teachers' Council.

This scheme lays great emphasis upon the question of the unification of the teaching profession, and makes provision for full representation upon the council of the universities of England and Wales. On this point Sir Robert Morant says:—